Learning Grounded Language For and From Interaction

Dr. Cynthia Matuszek
cmat@umbc.edu

University of Maryland,
Baltimore County
http://iral.cs.umbc.edu

My Research

- ## Artificial intelligence
  - How to get computers to behave in ways that we would consider to be "intelligent?"

- ## Human-Robot Interaction (HRI)
  - How can we put robots in human spaces?

- ## Robotics
  - How can we go from industrial robots to useful robots in human environments? (Schools, cars, homes…)

- ## Natural Language Processing
  - How can computers learn to understand and speak human languages (English)?

Background: Robots Now

- Robots now:
    - Expensive
    - Complex
    - Special-purpose

- Environments
    - Dedicated
    - Constrained

- Use and Management
    - Controlled by trained experts
    - Slow and expensive to reconfigure/repurpose
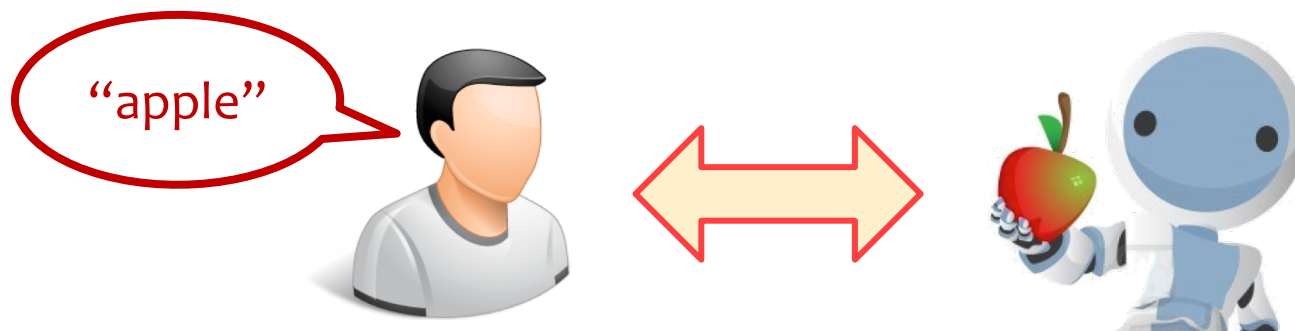
Home Robotics Now

- As technology improves:
  - Smaller, cheaper, more capable

- But still:
  - Very special purpose
  - Difficult (or impossible) to repurpose/modify

Interactive Robotics and Language Lab

Language ↔ Robotics

- How can language be grounded in physical, real-world concepts?

- Grounded Language Acquisition:
  - Learning language from **interaction with world**
  - Learning about the world **from language**

- Robotics ←→ NLP
  - NLP gains from having data source (learn "green" without it!)
  - Robotics gains because language is a great interface!

Predictability

- Predictability is key to trust and safety

- Requires *understanding* and *communication*

- Human-robot collaboration is often unintuitive

- The 1:1 problem
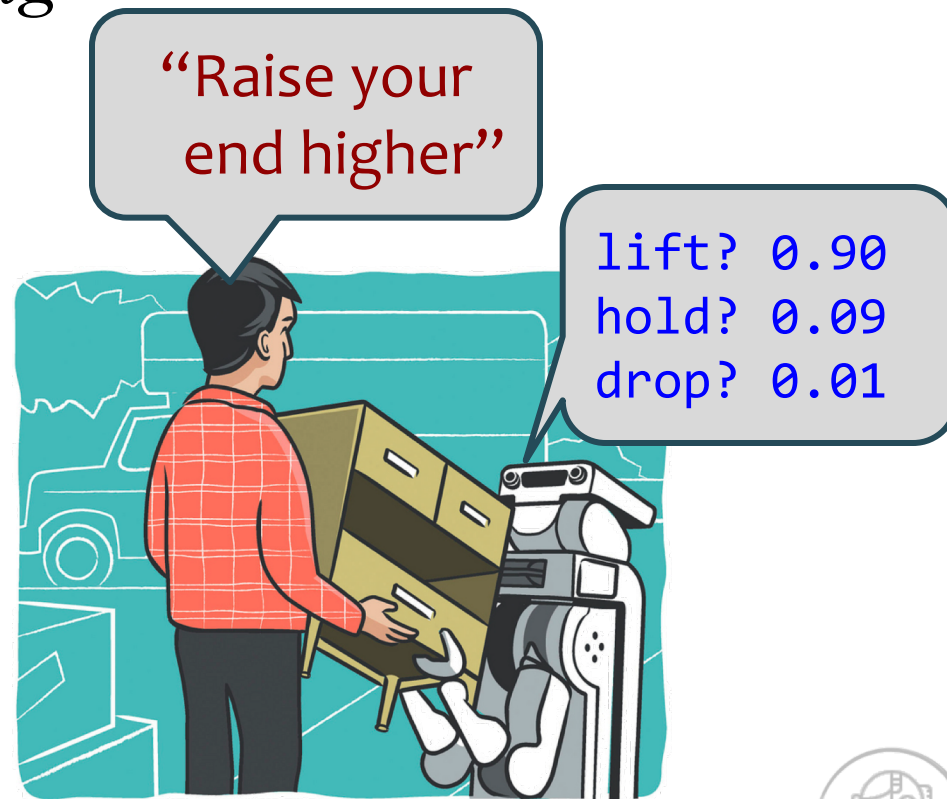
Natural Interactions

- Natural language based HRI
  - Natural, intuitive, unscripted
  - Broadly useful
  - Already widely known

- Learning language for *specific* tasks and users

"That's my yellow teapot!"

Interactive Robotics and Language Lab IRAL
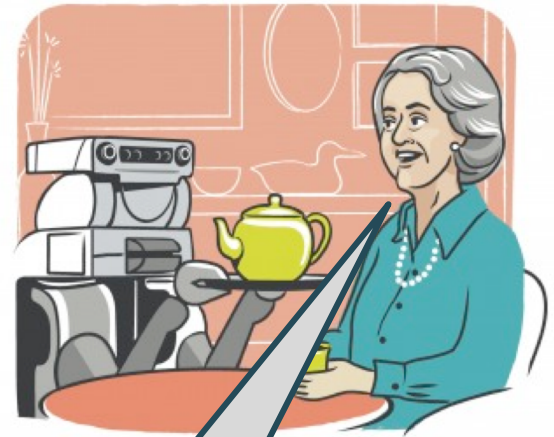
Motivation(s)

- It makes sense to learn language using percepts
  - Understanding "green" with vs. without a camera
  - Understanding "turn left" without motion

- Robots need to understand non-programmers
  - Robots are getting smaller, cheaper, more capable
  - Need natural, non-frustrating communications

Interactive Robotics and Language Lab
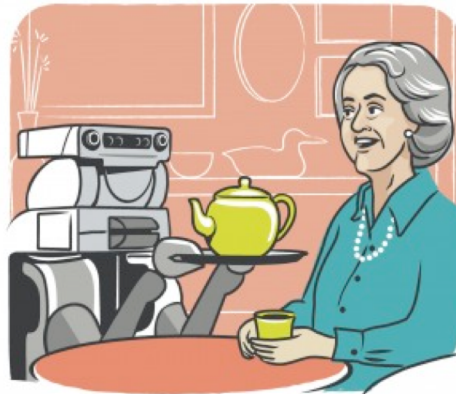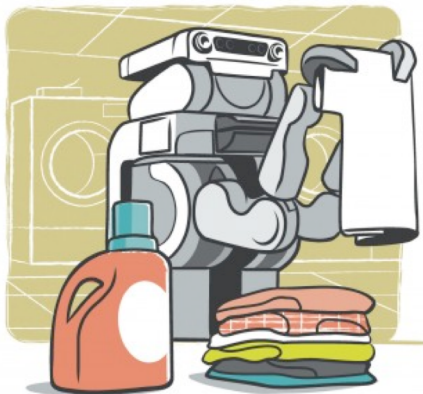
Learning About the World

- Learning novel language describing concepts

- Formal language definitions
  - turn-left, ...

- World modeling: new language **and concepts** from interactions
  - Associated with language
  - Grounded in percepts

red =
blue =
(eat??)
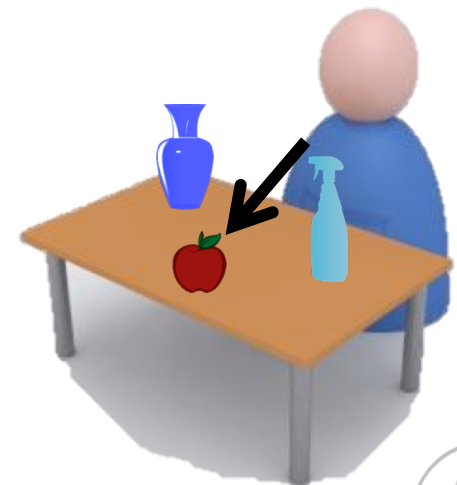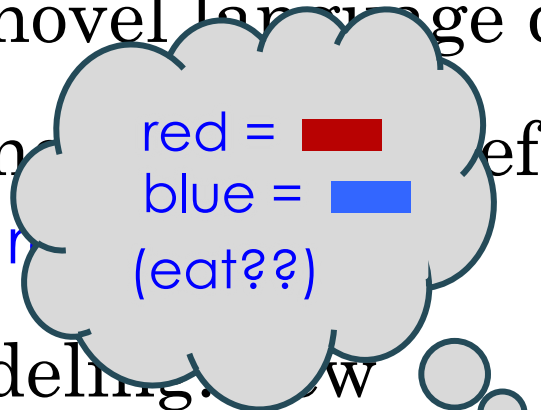
This is a red thing that you can eat, but don't eat these blue ones

"Could you please..."

AI at UMBC

- Machine Learning

- Robotics

- Natural Language Processing

- Vision and Visualization

- Knowledge Representation

- Planning and Inference

- AI and Security

- Fair and Explainable AI

Interactive Robotics and Language Lab IRAL